

NOTES ON THE MORPHOLOGY AND BIOLOGY OF ANABARRHYNCHUS
FASCIATUS MACQ. AND OTHER AUSTRALIAN THEREVIDAE
(DIPTERA, THEREVIDAE).

By KATHLEEN M. I. ENGLISH,

Department of Zoology, University of Sydney.

(Forty-seven Text-figures.)

[Read 29th November, 1950.]

INTRODUCTION.

The family Therevidae is of world-wide distribution and it is well represented in Australia. Tillyard (1926) gave the number of species as 56. Later, Mann (1928-1933) described new species and sank some names as synonyms, and he recognized 75 species in 14 genera; but he states: "It must be stressed that these are 'Revisional Notes' only, as insufficient material is available to allow a complete revision of the family."

No description has been found of the immature stages of any Australian species, and very little detailed information on the immature stages is available anywhere.

The earliest records I have seen of Therevidae larvae are by Bouché (1834) and Westwood (1840). The latter gives two other earlier references. Descriptions of larvae and pupae have been given by Brauer (1883), Williston (1896), Lundbeck (1908), Collinge (1909), Felt (1912), Malloch (1915), de Meijere (1916), Issac (1925), and Bhatia (1934).

In all these papers the descriptions of the larvae have family characteristics only, there are no details of the head or mouth-parts, and the text-figures by de Meijere, of mouth-parts, are the only ones which may have some generic characters.

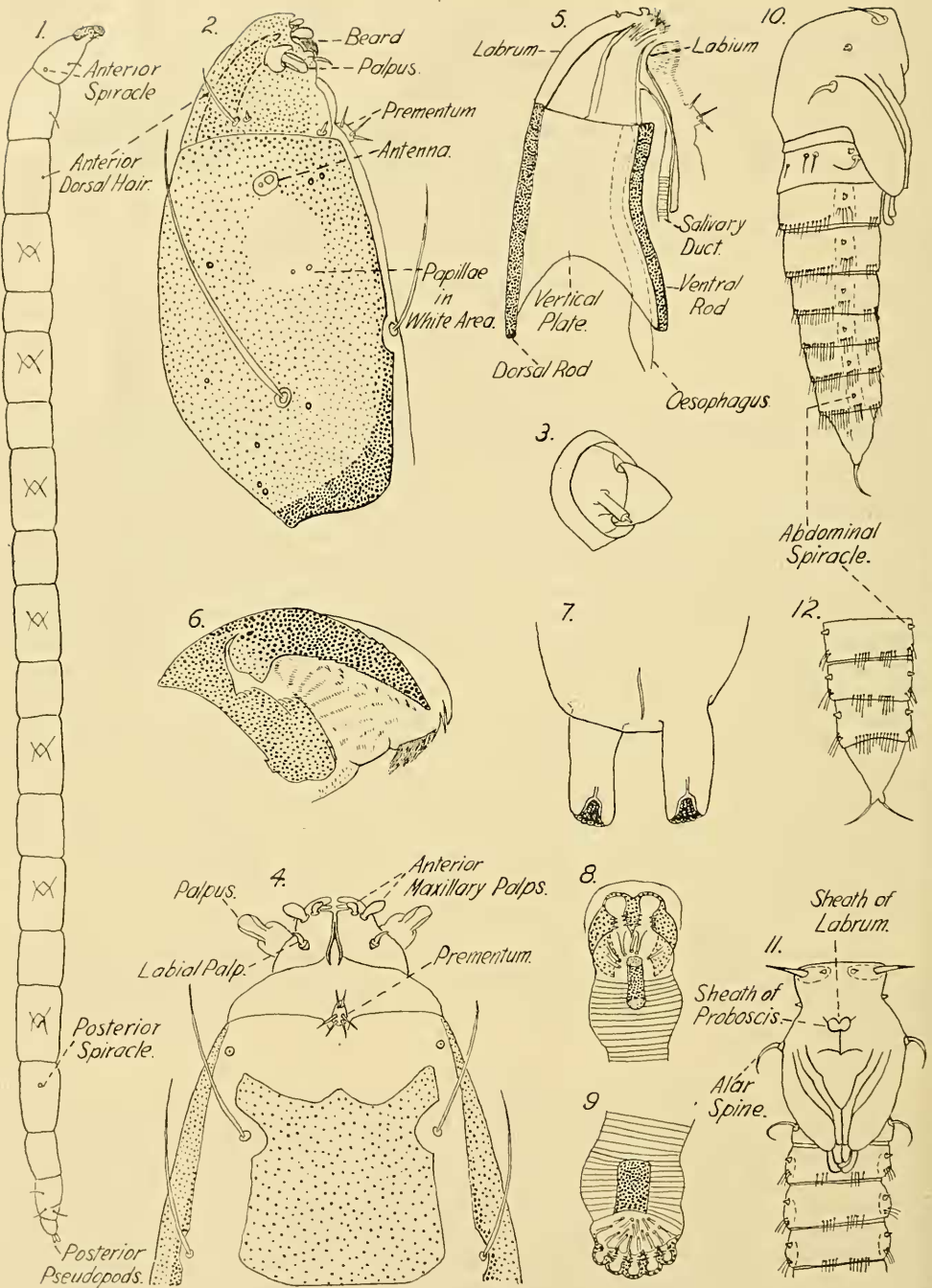
In this paper records are given of the occurrence of *A. fasciatus* Macq., and the larva and pupa are described in some detail. Records are given also of the occurrence of eight other species, and the larva and pupa of each is described briefly, it being considered necessary to describe only the features that distinguish the species.

ANABARRHYNCHUS FASCIATUS Macquart. Text-figures 1-13.

A. fasciatus was described by Macquart (1848), but the description is more accessible in Australia in Mann's Revisional Notes, pt. 1, p. 151 (1928). In 1947, when specimens were submitted to him for identification, Mr. Mann states: "It is a species that I know from Sydney only."

Occurrence.

Many larvae were found in the sandy soil of a small garden at Rose Bay, Sydney, N.S.W. They were particularly numerous in two small plots where fruit fell from the overhanging branches of a peach tree. The peaches were infected with fruit fly, and in January, 1947, the garden was left untended for some weeks, the fallen fruit accumulated and fruit fly and other larvae developed unhindered. In February, when this decaying fruit was being picked up, one large Therevid larva was seen on the soil under the remains of one peach; and in March, when the soil was being dug over where the fallen fruit had lain, nine Therevid larvae were turned up in a few minutes. In April, during a week-end of gardening, thirty larvae of various sizes were found, but only ten of the larger ones were kept. From March to October, 1947, 91 Therevid larvae were collected in various parts of the small garden and many more were seen but not taken. Many were found near the surface and were uncovered by just scratching the top soil; others were found deeper down when digging, but it was not possible to determine at what depth exactly they were in the soil. In colour most of them were white or cream, but some of those found in October had a distinct pink tinge;



Text-figures 1-12. *Anabarrhynchus fasciatus*.

1. Larva, lateral view, $\times 7\frac{1}{2}$.
2. Head of larva, lateral view, $\times 120$.
3. Antenna of larva, $\times 500$.
4. Head of larva, ventral view, $\times 120$.
5. Vertical section of larval head, showing labrum and labium, $\times 120$.
6. Mandible and maxilla of larva, $\times 185$.

others appeared to have alternating dark and light bands; this was evidently due to some dark-coloured foodstuff showing through the thin-walled part of the segments.

The larvae are carnivorous and it was necessary to keep each larva in a jar or tube by itself, for if several were left together overnight there would be only one surviving in the morning. No real attempt was made to supply the larvae with food. In the soil under the peach trees were many larvae and pupae of fruit fly and another Acalyptrate fly. Some of these were given to a few of the Therevid larvae and were apparently acceptable, as the larvae were consumed and some of the pupae were pierced and the contents extracted.

When found many of the larvae had small mites attached to them; and some had brown spots on the skin, evidence of some diseased condition, for these did not survive long; others, after having been kept in captivity for a time, developed this condition and later died.

Of the larvae collected at Rose Bay in 1946 and 1947, 48 pupated, and from these there emerged 31 of *A. fasciatus* and four of other species. Seven pupae were parasitized by a Bombyliid, of which four adults emerged and three were dissected out in the pupal stage. One adult of *A. fasciatus* was obtained from a larva collected in 1946 in the Hornsby valley, and seven adults were obtained from larvae collected at Woolwich in 1949.

The pupal period varied from 26–28 days in early September to 14–15 days in the latter part of October, and 10 days for one specimen in February.

Some adults were collected in the garden at Rose Bay, but not as many were seen as might have been expected from the number of larvae in the soil. No eggs were found nor was egg laying observed.

Larva. Text-figures 1–9 and 13.

The larva (Text-fig. 1) is about 25 mm. long and about 1 mm. in width. It has a dark brown chitinized non-retractile head and a long slender body consisting of three thoracic and ten abdominal segments. The thoracic segments each bear a pair of latero-ventral hairs, the first segment tapers anteriorly to the small head, and near its posterior border is situated the anterior spiracle. The first six abdominal segments are each divided by a constriction into two parts, and the first seven segments have, laterally, a pattern of depressed lines. The eighth segment bears the posterior spiracles. The tenth segment is divided by a constriction into two parts: the proximal part bears three pairs of hairs and the distal part bears the anus on the ventral surface and two pseudopods at the apex.

The Head.—The head (Text-fig. 2) is about $\frac{1}{2}$ mm. long, it is broad posteriorly and tapers to a point anteriorly, it is rounded on the dorsal surface and is almost flat on the ventral surface. The epicranium is a shining brown, the posterior edge is much darker, and laterally there is a white or colourless area of an irregular shape. On each side of the epicranium are ten or more papillae, two of which occur, one above the other, in the posterior end of the white area. At the anterior edge of this area is the antenna (Text-fig. 3), a curious structure of two very dissimilar parts, the larger part shaped like a pointed dome on a short thick stalk, the smaller part shaped like a candle, with a pointed palp at the top, and the whole encircled by a ridge. On the posterior portion of the epicranium is a large forwardly directed bristle or hair.

On the ventral surface of the epicranium (Text-fig. 4) there is a large chitinized ventral plate, and on each side of it are two long bristles and one papilla.

Internally the box-like "pharynx support" through which runs the oesophagus (Text-fig. 5) is very similar in arrangement to that described for *Apiocera maritima* Hardy (These PROCEEDINGS, lxxi, p. 298, 1947).

7. Posterior end of larval exuvia with pseudopods, $\times 120$.

8. Anterior spiracle of larva, surface view, $\times 185$.

9. Posterior spiracle of larva, surface view, $\times 185$.

10. Pupa, lateral view, $\times 7\frac{1}{2}$.

11. Pupa, anterior end, ventral view, $\times 7\frac{1}{2}$.

12. Pupa, posterior end, ventral view, $\times 7\frac{1}{2}$.

The anterior portion of the head contains the mouth-parts and bears bristles and palps externally. On each side near the lateral posterior edge are three bristles (Text-fig. 2). The one nearest the median line I have called the anterior dorsal hair; it is much longer than the one immediately below; near the ventral edge is another short bristle. In front of these is a large two-jointed palpus. On the ventral surface (Text-fig. 4) is a centrally situated fleshy lobe armed with six spines, called by de Meijere (1916) the prementum. Further forward are a pair of slender labial palps, and near the anterior edge are two pairs of lobes or palps, which I have called the anterior maxillary palps.

Mouth-parts. The labrum (Text-fig. 5) curves downwards and the anterior part is hidden by the mandibles when the head is viewed from the side. In the anterior part of the labrum there is a pair of small spines set in a depression; nearer the apex the edge forms an upturned peak, and below this the chitin is armed with spines and hairs. Below the labrum is the hypopharynx, articulated posteriorly to the ventral rods, and from it the salivary duct runs back below the ventral rods. Below the hypopharynx is the labium, a laterally compressed structure composed of a chitinous rod above with fleshy lobe below covered with fine hairs or spines. The arrangement and shape of the hypopharynx and labium is very similar to that described for *Apiocera maritima* Hardy. On each side of the labrum are the strongly chitinized pointed mandibles (Text-fig. 6) with a fine saw-tooth lower edge and some small barbs on the upper edge. The maxillae are set outside the mandibles, they are not heavily chitinized, and, as well as the small anterior palps, they are provided with a beard, or thick tuft, of long hairs.

Behind the head is the capsule rod (Text-fig. 13). It articulates with the posterior dorsal peak of the epicranium and extends through the prothorax into the anterior part of the mesothorax and can be seen through the skin; in the live larvae it can be seen moving actively with the movements of the head. The rod is about 1 mm. in length, it is strongly chitinized and further strengthened by very heavy chitin in the shaft and in the distal portion of the wider part.

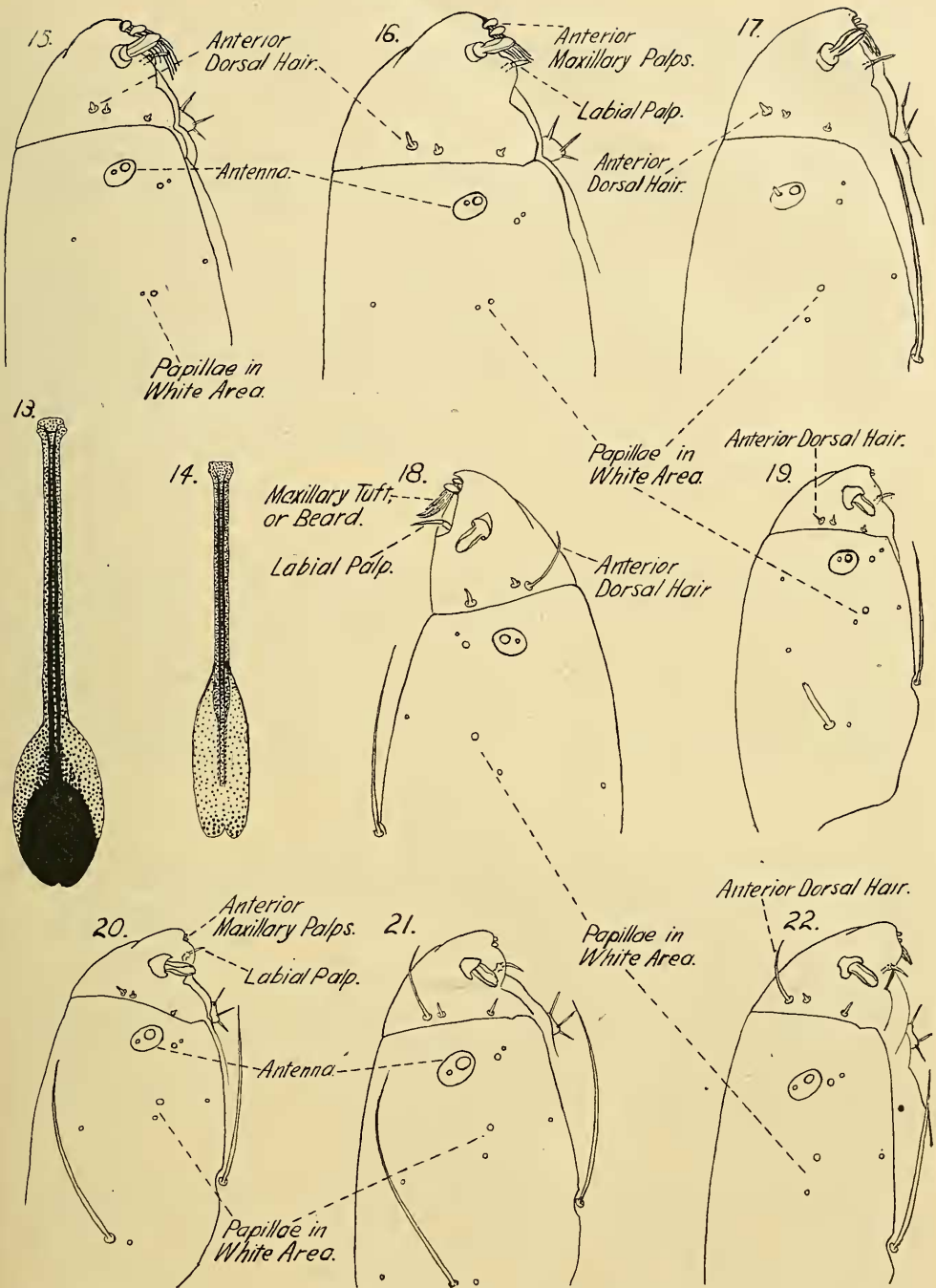
The posterior pseudopods are used continuously for locomotion when they are turned downwards at right angles to the body; they are about half the length of the distal part of the last segment. In the larva itself no structure is visible in the pseudopods, but in the larval exuvia a very definite chitinized structure is visible (Text-fig. 7); this probably enables the larva to grip surfaces by suction.

The spiracles (Text-figs. 8 and 9). The anterior pair are situated on the posterior part of the prothorax, and the posterior pair are on the eighth abdominal segment. Both pairs are strongly chitinized and show up on the live larva as almost black spots.

Pupa. Text-figures 10, 11 and 12.

Pupal exuviae vary in length from 8-9 mm. The head bears a pair of slender antennal processes, each ending in a slender spine. The sheath of the labrum is very short and does not extend to the edge of the sheath of the proboscis. On the thorax there is a strong alar spine on each side at the base of the wing sheath; and each spiracle is placed on a small high tubercle. The first abdominal segment bears, on each side, one long spine laterally near the spiracle, and three small dorso-lateral spines. The second and succeeding abdominal segments, except the last, each have a single incomplete row of fine bristles near the posterior edge; the bristles are mostly short on the second segment and they increase in length on each succeeding segment. On the dorsal surface the bristles are numerous; on the ventral surface there are six or seven on the second segment and they increase on each succeeding segment to twelve or thirteen in the last row. Laterally there are four or five bristles below the spiracle on each lateral prominence. The last segment bears on each side two very small bristles, and it ends in two tubercles, each bearing a long spine. The abdominal spiracles are on small high tubercles.

No difference could be found between the male and female pupae of this species, though there are very slight differences noted in the other species described in this paper.



Text-figures 13-22.

13. *Anabarrhynchus fasciatus*, capsule rod of larva, $\times 60$.
 14. *Acupalpa semiflava*, capsule rod of larva, $\times 60$.
 15. *Platycarenum quinquevittata*, head of larva, lateral view, $\times 120$.
 16. *Anabarrhynchus maritimus*, head of larva, lateral view, $\times 120$.
 17. *Ectinorrhynchus variabilis*, head of larva, lateral view, $\times 120$.
 18. *Taenogera superbus*, head of larva, lateral view, $\times 120$.
 19. *Acraspisa trifasciata*, head of larva, lateral view, $\times 150$.
 20. *Acupalpa semiflava*, head of larva, lateral view, $\times 120$.
 21. *Agapophytus albobasalis*, head of larva, lateral view, $\times 120$.
 22. *Agapophytus aterrimus*, head of larva, lateral view, $\times 120$.

PLATYCARENUM QUINQUEVITTATA Macquart. Text-figures 15, 23-26.

Recorded by Mann from N.S.W. and Tasmania.

Occurrence.

Adults were collected at Narooma in January, 1937 and 1938, on beach sand; and at Cronulla, on 5th October, 1947, among grasses on the sand-dunes behind the beach, where they were very numerous, and there were many mating couples; three pairs were caught.

Larvae were collected at Narooma, Cronulla and Yarra Bay (Botany Bay). The larvae are found in sand, either in the beach above high-water mark or in the dunes and sand-hills behind the beach. They travel at times just below the surface of the sand and leave behind a fine line, or track, of raised sand in a very minute "rick-rack" pattern. These fine tracks, about one or two mm. in width, sometimes extend for long distances and are often very numerous. There was no opportunity to observe whether these tracks occur at any time of the year or only at certain seasons; nor was it possible to determine for how long they would remain on the sand if not levelled by rain or blown away by wind.

Narooma: In November, 1938, two large larvae were found in surface sand on the beach.

Cronulla: In May, 1947, six larvae were collected in the sand-hills behind the beach; they were found by scraping away the top sand at the ends of the "rick-rack" tracks.

Yarra Bay: In July, 1948, one larva was found among the roots of the spinifex growing in the sand at the back of the beach. It had its mouth-parts sunk into a small beetle pupa, and it continued to feed even after being uncovered. In October, 1948, five larvae were found among spinifex roots in the sand. Many Lepidoptera and some Coleoptera larvae were present also in the sand among the grass roots. Four adults were obtained from these larvae—two males and two females—and the pupal period was obtained for two. One emerged in early December (pupal period 18 days); one emerged in early February (pupal period 16 days).

Larva. Text-figure 15.

The larvae are large, up to 30 mm. in length and 1.5 mm. in width. On the epicranium the two papillae in the white area are placed close together and one above the other. The anterior dorsal hair is short, the anterior maxillary palps large, and maxillary tuft long and strong. The labrum has a small indentation, but it lacks the distinct upturned peak of *A. fasciatus*.

The capsule rod is heavily chitinized and shaped as in *A. fasciatus* (Text-fig. 13). The posterior pseudopods are minute, less than one-fifth of the length of the distal part of the last segment. The spiracles are not very heavily chitinized.

The dark capsule rod shows very conspicuously through the skin of the thorax; this and the minute posterior pseudopods make it possible to determine the species of the live larva if the habitat is known.

Pupa. Text-figures 23-26.

Pupal exuviae vary in length from 8 to 9 mm. The head bears slender antennal processes, each terminating in a long spine. The sheath of the labrum is short. The thorax bears a long alar spine on each side; the spiracles are each on a small high tubercle.

The first abdominal segment bears on each side one long spine laterally, near the spiracle, and three long dorso-lateral spines. The second and succeeding abdominal segments, except the last, bear fine bristles near the posterior edge. On the dorsal surface the bristles are in two rows: an anterior row of shorter bristles which become shorter on each succeeding segment, and a posterior row of longer bristles which become longer on each succeeding segment. On the ventral surface the bristles are long and short, irregularly placed; they become longer on each succeeding segment. On the lateral prominences there are short and long bristles; the number and arrange-

ment is irregular. The last segment is divided by a constriction into two parts. The proximal part bears laterally ten or twelve bristles, short and long; the distal part bears at the apex two small thin bristles. The abdominal spiracles are borne on very small tubercles.

In the male pupa (Text-fig. 25), on the last segment, in addition to the lateral bristles, there are nine or ten short bristles on the ventral surface.

ANABARRHYNCHUS MARITIMUS Hardy. Text-figures 16 and 27-29.

Recorded by Mann from Tasmania, N.S.W. and Queensland.

Occurrence.

Adults were collected at Narooma in January, 1937, 1938, 1939, and in November, 1938. More were collected at Cronulla on 5th October, 1947, where they were numerous on the tall grasses on the sand-dunes behind the beach. Some mating couples were seen and one pair was caught.

One larva was found at Yarra Bay, 10th July, 1948, among the roots of spinnex growing in sand at the back of the beach. On 13th September it had pupated and on 9th October a male emerged before 8 a.m. This was the only specimen obtained from a larva.

Larva. Text-figure 16.

No measurement was made of the larva before it pupated. On the epicranium the two papillae in the white area are placed close together, one above and a little behind the other. The anterior dorsal hair is short, anterior maxillary palps large, and maxillary tuft long and strong. The labrum has a very small prominence near the apex, but it has not the distinct peak of *A. fasciatus*. The capsule rod is heavily chitinized and shaped as in *A. fasciatus* (Text-fig. 13). In the larval exuvia the posterior pseudopods are about the same length as in *A. fasciatus* and they have the same structure at the extremity (Text-fig. 7), though not quite so heavily chitinized. The spiracles are fairly heavily chitinized.

Pupa. Text-figures 27, 28 and 29.

The pupal exuvia is 9 mm. long. The head bears slender antennal processes, each ending in a slender spine. The sheath of the labrum is short. The thorax bears a long alar spine on each side; the spiracles are each on a small tubercle.

The first abdominal segment bears, on each side, a long bifid spine near the spiracle, and two long dorso-lateral spines. The second and succeeding abdominal segments, except the last, bear a single incomplete row of fine bristles near the posterior edge, and most of these become longer on each succeeding segment. On the dorsal surface the bristles are numerous on the second segment, but the number is reduced a little on succeeding segments. On the ventral surface there are seven to nine bristles on each side of a central space. On the lateral prominences there are seven to nine bristles on segments two to six, and five on the seventh. The last segment is divided by a constriction, the proximal part bears laterally two short bristles, and on the ventral surface four short bristles. The distal part bears, at the apex, two very small spines. The abdominal spiracles are borne on very small tubercles.

No female pupa was obtained for comparison.

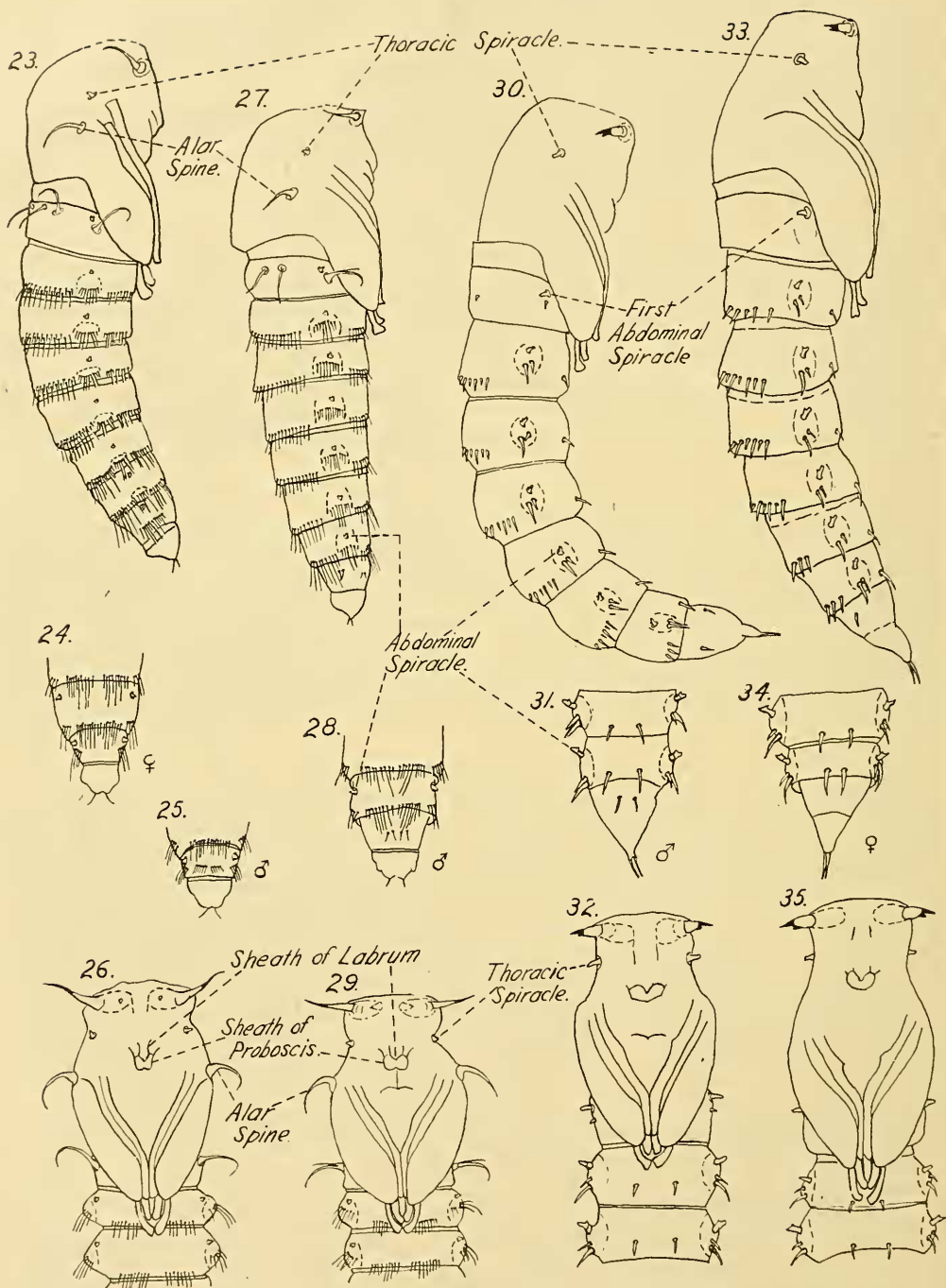
ECTINORRHYNCHUS VARIABILIS Macquart. Text-figures 17 and 30-32.

Recorded by Mann from Tasmania, N.S.W., Queensland and Western Australia.

Occurrence.

No adults were collected.

Among the larvae of *A. fasciatus* collected in garden soil at Rose Bay in April, 1947, was one from which a male of this species emerged in September; and two males emerged from larvae collected in garden soil at Woolwich, one in September, 1949 (pupal period 33 days), and one in August, 1950. These were the only specimens obtained.



Text-figures 23-35. Pupae, showing lateral view of whole pupa and ventral views of anterior and posterior ends of pupae.

23, 24, 25, 26. *Platycarenum quinquevittata*, $\times 7\frac{1}{2}$.

27, 28, 29. *Anabarrhynchus maritimus*, $\times 7\frac{1}{2}$.

30, 31, 32. *Ectinorrhynchus variabilis*, $\times 7\frac{1}{2}$.

33, 34, 35. *Tacnogerger superbus*, $\times 7\frac{1}{2}$.

Larva. Text-figure 17.

No measurements were made of these larvae before they pupated. On the epicranium the two papillae in the white area are placed well apart, one behind and slightly above the other. The anterior dorsal hair is short. The anterior maxillary palps are smaller than in the previous species described, but they are as long as the basal segment of the labial palp. In the maxillary tuft the hairs are sparse. The labrum has no peak near the apex.

The capsule rod is shaped as in *A. fasciatus* (Text-fig. 13), but not quite so heavily chitinized. In the larval exuvia the posterior pseudopods appear to be nearly as long as in *A. fasciatus*, and they have the same heavily chitinized structure (Text-fig. 7). The spiracles are fairly heavily chitinized.

Pupa. Text-figures 30, 31 and 32.

The pupal exuviae are 10-11 mm. in length. The head bears short thick antennal processes, each bearing a short strong spine with a very short spine at its base.

The sheath of the labrum is short. There are no alar spines on the thorax; the spiracles are each on a long slender tubercle.

The first abdominal segment bears on each side one very small thorn-like spine laterally near the spiracle, and one very small dorso-lateral spine, but in one specimen there were no spines on this segment. The second and succeeding segments, except the last, are armed with spines near the posterior edge. On the dorsal surface, on segments two to five, there are about twelve spines, long and short; segment six may be like segment five or more like segment seven; on segment seven there are six long spines. On the ventral surface on segments two to seven are two spines placed well apart; they increase in length on each succeeding segment. On the lateral prominences, on segments two to six, are two spines, one long and one short; on segment seven they are both long. The last segment bears, on the anterior portion, one short spine laterally and two short spines ventrally; the distal portion bears at the apex two long spines. The abdominal spiracles are borne on long slender tubercles, and on segments three to seven these bear a small peak on the anterior edge.

No female pupae were obtained for comparison.

TAENOGERA SUPERBUS Schiner. Text-figures 18 and 33-35.

Recorded by Mann from Queensland and N.S.W.

Occurrence.

Two adults, a mating couple, were collected at Yass, N.S.W., in December, 1928.

Three larvae were found in soil at Yass in August, 1930, and from these emerged two females and one male in November. The pupal period was not obtained.

Larva. Text-figure 18.

The largest larva was 24 mm. in length. On the epicranium the two papillae in the white area are placed well apart, one behind and slightly above the other. The anterior dorsal hair is long. The largest of the anterior maxillary palps are as long as the basal segment of the labial palp. This species appears to have an extra pair of maxillary palps covered with hairs instead of the maxillary tuft of the other species in this paper. The labrum has a very small peak near the extremity. The capsule rod is shaped as in *Acupalpa semiflava* (Text-fig. 14), but it is not so heavily chitinized. In the larval exuvia there is no chitinized structure at the extremity of the posterior pseudopods. The spiracles are not heavily chitinized.

Pupa. Text-figures 33, 34 and 35.

The longest pupal exuvia was 12 mm. in length. The head bears short thick antennal processes, each terminating in a strong spine with a very small spine at its base.

The sheath of the labrum is short. On the thorax there are no alar spines; the spiracles are each on a long slender tubercle.

There are no spines on the first abdominal segment. The second and succeeding abdominal segments, except the last, are armed with strong spines near the posterior edge. On the dorsal surface, on segments two to five, there are ten to fourteen spines, long and short; on segments six and seven there are six long spines. On the ventral surface, on segments two to seven, there are two spines placed apart; on the seventh segment the spines are longer and placed closer. On the lateral prominences, on segments two to seven, there are two spines, one long and one short. The last segment is divided by a constriction into two parts; on the proximal part, on each side, is one small dorso-lateral spine. The distal part bears at the apex two long spines. The abdominal spiracles are borne on long slender tubercles, and on segments three to seven these bear a small peak on the anterior edge.

The male pupa bears, in addition, on the last segment two small spines on the ventral surface.

ACRASPISA TRIFASCIATA Krober. Text-figures 19 and 36-38.

Recorded by Mann from N.S.W. and Northern Territory of Australia.

Occurrence.

Adults were collected at Yass, N.S.W., where they were numerous in October, 1932.

Two larvae were found in soil at Yass in August and October, 1930; from these emerged a male and a female in November. The pupal period was not obtained.

Larva. Text-figure 19.

The larvae were about 14 mm. in length. On the epicranium the two papillae in the white area are placed close together, one behind and a little above the other. The anterior dorsal hair is short. The anterior maxillary palps minute, maxillary tuft scant or absent. The shape of the labrum could not be determined. The capsule rod is shaped as in *Acupalpa semiflava* (Text-fig. 14), but is not so heavily chitinized. In the larval exuvia the posterior pseudopods have some structure at the extremity but it is not chitinized and its formation could not be determined. The spiracles are not heavily chitinized.

Pupa. Text-figures 36, 37, 38.

The pupal exuviae are 6 mm. in length. The head bears short thick antennal processes, each terminating in a slender spine which may have a minute spine at its base.

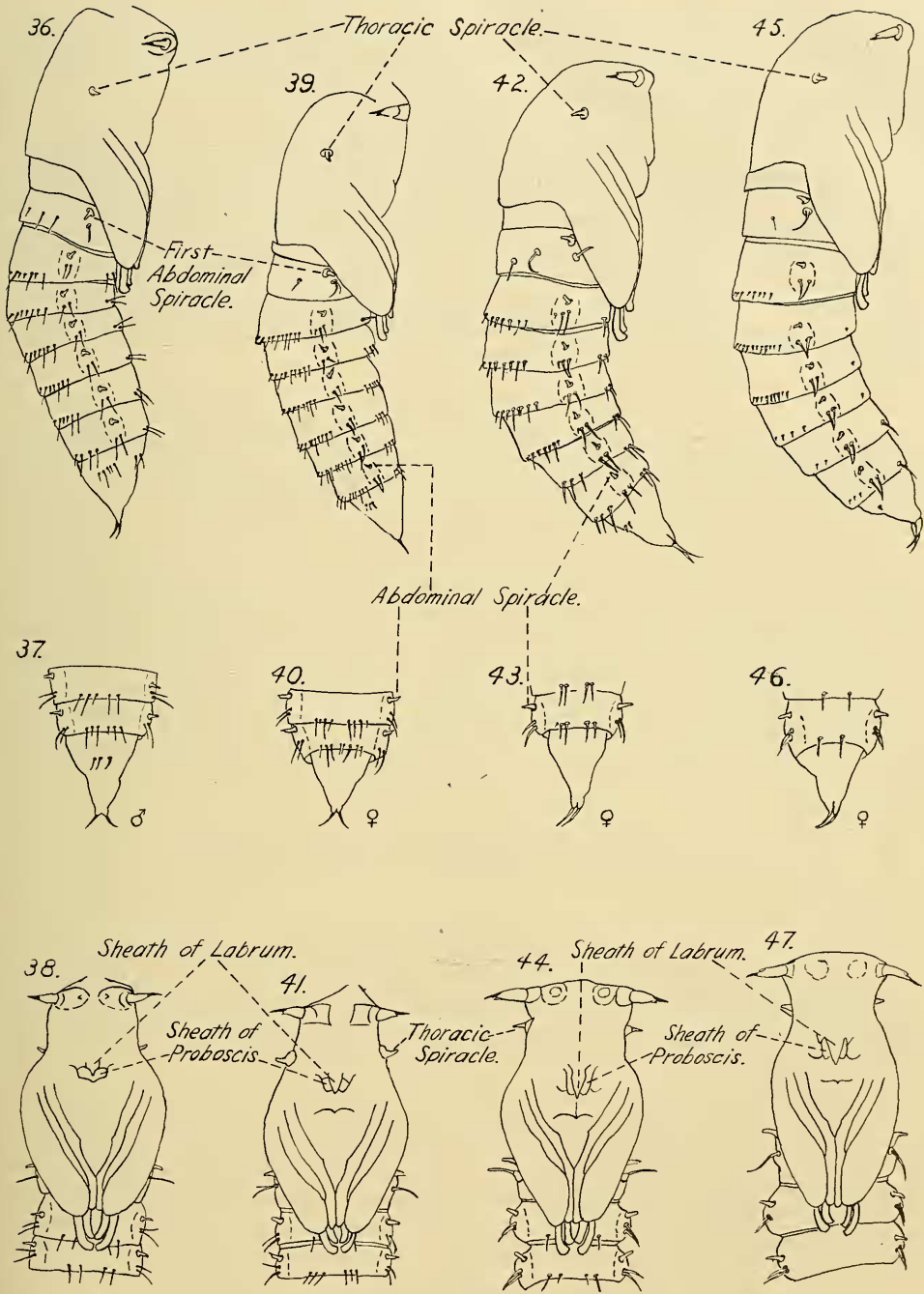
The sheath of the labrum, is short. On the thorax there are no alar spines; the spiracles are each on a long slender tubercle.

The first abdominal segment bears, on each side, one strong bristle laterally near the spiracle, and three very slender dorso-lateral bristles. The second and succeeding segments, except the last, are armed with long bristles and short spines near the posterior edge. On the dorsal surface, on segments two to six there are six slender bristles and eight short spines; on the seventh segment are six bristles but only two or three very small spines. On the ventral surface, on segments two to seven there are four long bristles and one or two short bristles also on segments six and seven. On the lateral prominences, on segments two to seven are two long bristles. The last segment bears, on each side, four or five long and short dorso-lateral bristles, and on the ventral surface in the male pupa are three strong bristles. Apically the last segment ends in two tubercles, each ending in a spine. Abdominal spiracles are borne on tall slender tubercles.

In the female pupa the short spines are more numerous on the dorsal surface of all abdominal segments. The last segment bears two or three long dorso-lateral bristles on each side, and there are no bristles on the ventral surface.

ACUPALPA SEMIFLAVA Mann. Text-figures 14, 20, 39-41.

Recorded by Mann from Queensland.



Text-figures 36-47. Pupae, showing lateral view of whole pupa and ventral views of anterior and posterior ends of pupae.

36, 37, 38. *Acraspisa trifasciata*, $\times 12$.

39, 40, 41. *Acupalpa semiflava*, $\times 7\frac{1}{2}$.

42, 43, 44. *Agapophytus albobasalis*, $\times 7\frac{1}{2}$.

45, 46, 47. *Agapophytus aterrimus*, $\times 7\frac{1}{2}$.

Occurrence.

One adult was collected at Yass, N.S.W., in October, 1932. Two larvae were found in soil at Yass in September, 1932, and from these two females emerged in November and December. The pupal period was not obtained.

Larva. Text-figures 14, 20.

No measurements were made of the larvae before they pupated. On the epicranium the two papillae in the white area are placed close together, one behind the other. The anterior dorsal hair is short, the anterior maxillary palps minute, maxillary tuft scant or absent. The curved labrum has no peak or depression. The capsule rod (Text-fig. 14) is shorter than in *A. fasciatus*, the shaft is not so heavily chitinized, the wide part is longer and narrower and has no heavily chitinized portion at the posterior end. In the larval exuvia the posterior pseudopods are very short and the extremity is not chitinized. The spiracles are not heavily chitinized.

Pupa. Text-figures 39, 40, 41.

Length of pupal exuviae 8 mm. The head bears short thick antennal processes, each bearing a slender spine, with a small basal spine. Sheath of the labrum is long; it reaches beyond the sheath of the proboscis. On the thorax there are no alar spines; the spiracles are each on a high slender tubercle on a rounded base.

The first abdominal segment bears, on each side, one slender bristle (sometimes bifid) near the spiracle, and one dorso-lateral bristle. The second and succeeding segments, except the last, bear bristles and spines near the posterior edge. On the dorsal surface, on segments two to seven, are long bristles and short spines, irregularly placed. On the ventral surface, on segments two to seven, are long and short bristles, irregularly placed. On the lateral prominences, on segments two to seven, are two long bristles, and in some cases some short bristles also. The last segment bears, on the proximal part, three small dorso-lateral bristles on each side; the distal part divides at the apex into two small tubercles, each ending in a spine. The abdominal spiracles are borne on long slender tubercles and, on segments two to seven, these terminate in a small spine. There is no male pupa for comparison.

AGAPOPHYTUS ALBOBASALIS Mann. Text-figures 21, 42-44.

Recorded by Mann from Queensland, N.S.W. and South Australia.

Occurrence.

Two adults, a mating pair, were collected at Yass, N.S.W., in December, 1929.

Larvae were found in 1930 at the same locality, and from these seven adults emerged, four females and three males. Pupal periods obtained were 22-23 days for two females which emerged on December 6, and 17 days for a male which emerged on December 10.

Larva. Text-figure 21.

Larvae varied in length from 20 to 23 mm. On the epicranium the two papillae in the white area are placed well apart, one behind the other. Anterior dorsal hair is long, anterior maxillary palps minute. The maxillary tuft scant or absent. The labrum has no peak or depression. The capsule rod is shaped as in *Acupalpa semiflava* (Text-fig. 14). In the larval exuvia the posterior pseudopods are very short and they have no chitinized structure at the extremity. The spiracles are not heavily chitinized.

Pupa. Text-figures 42, 43, 44.

Length of pupal exuviae 9 mm. The head bears thick antennal processes, each terminating in a strong spine which may have a minute spine at its base. The sheath of the labrum is long. On the thorax there are no alar spines; the spiracles are each on a long slender tubercle on a round base.

The first abdominal segment bears, on each side, a long strong bristle near the spiracle and two strong dorso-lateral bristles. The second and succeeding segments,

except the last, bear short spines and long bristles near the posterior edge. On the dorsal surface, on segments two to five, are short spines and long bristles, irregularly placed; on segments six and seven are six long bristles. On the ventral surface, on segment two are two long bristles; on segment three are two long and two short; and on segments four to seven are four long bristles. On the lateral prominences, on segments two to seven are two long bristles and in some cases a short one also. The last segment bears, in the female pupa, two small dorso-lateral bristles on each side; the distal part divides into two tubercles, each bearing a long spine. The spiracles are borne on long slender tubercles and, on segments two to seven, these each end in a very small spine. The male pupa bears on the proximal part of the last segment two very small spines on the ventral surface.

AGAPOPHYTUS ATERRIMUS Mann. Text-figures 22, 45-47.

Recorded by Mann from Queensland, N.S.W. and Victoria.

Occurrence.

No adults were collected.

Larvae were found at Yass, N.S.W., in 1930, mostly in the soil at the base of hollow rotting tree stumps, and from these three females and one male emerged in December. Pupal periods obtained were: 25 days for one male, which emerged on 5th December, and 18 days for one female, which emerged on 13th December.

Larva. Text-figure 22.

The largest larvae were 27 mm. in length. On the epicranium the two papillae in the white area are placed well apart, one behind the other. The anterior dorsal hair is long, anterior maxillary palps minute, maxillary tuft short and thick. The labrum has no peak or depression. The capsule rod is shaped much as in *Acupalpa semiflava* (Text-fig. 14), but in some specimens it is more heavily chitinized at the posterior end. In the larval exuvia the posterior pseudopods are short and there is no chitinized structure at the extremity. The spiracles are fairly heavily chitinized.

Pupa. Text-figures 45, 46, 47.

Length of pupal exuviae 9-11 mm. The head bears thick antennal processes, each ending in a thin spine with a minute spine beside it. The sheath of the labrum is long. On the thorax there are no alar spines; the spiracles are each borne on a long slender tubercle.

The first abdominal segment bears, on each side, one long strong bristle near the spiracle and one short slender dorso-lateral bristle. On the dorsal surface, on segments two to four, near the posterior edge, are numerous short strong spines; on segments five to seven the spines are short, slender and few in number. On the ventral surface segments two to five may bear two minute spines or none; segments six and seven bear two long strong spines. The lateral prominences each bear two long strong spines. The last segment bears, on each side, one very small dorso-lateral spine in the female pupa; the distal part ends in two tubercles, each bearing a spine. The spiracles are borne on long slender tubercles.

The male pupa bears on the proximal part of the last segment two small strong spines on the ventral surface, and there may be an additional very small latero-dorsal spine on each side.

NOTES ON HABITS.

In the prepupal stage the larvae of the Therevidae assume a very characteristic position. The larva lies in the soil in a curved position somewhat like the letter U, or almost in a circle; if it is uncovered the larva straightens itself and slowly makes its way below the surface of the soil, then re-assumes its curved position. The hard skin of the larva does not allow it to contract very much, the thoracic segments are slightly shortened and become bead-like in appearance, and the abdominal segments contract a little.

Adult Therevidae are fairly numerous, but not as many are to be seen as might be expected from the prevalence of the larvae; they fly lazily, and some species fly with the legs hanging downwards, in the manner of certain wasps.

TENTATIVE KEYS FOR THE GENERA DESCRIBED IN THIS PAPER.

Larvae.

1. Anterior maxillary palps as long as, or longer than, the basal segment of the labial palp, as in Text-figure 16 2
Anterior maxillary palps minute, as in Text-figure 20 5
2. Papillae in lateral white area of head placed one above the other, or nearly so, as in Text-figures 15 and 16 3
Papillae in lateral white area of head placed one well behind the other, as in Text-figure 17 4
3. Posterior pseudopods minute, less than one-fifth of the length of the distal part of the last segment *Platycarenum*
Posterior pseudopods long, about half the length of the distal part of the last segment (Text-fig. 1) *Anabarrhynchus*
4. Anterior dorsal hair short (Text-fig. 17) *Ectinorrhynchus*
Anterior dorsal hair long (Text-fig. 18) *Taenogera*
5. Anterior dorsal hair short, as in Text-figure 19 6
Anterior dorsal hair long (Text-figs. 21 and 22) *Agapophytus*
6. Papillae in lateral white area of head about as far apart as papillae below antenna (Text-fig. 19) *Acraspisa*
Papillae in lateral white area of head about twice as far apart as papillae below antenna (Text-fig. 20) *Acupalpa*

Pupae.

1. Thorax with alar spine, as in Text-figure 23 2
Thorax without alar spine 3
2. Dorsal abdominal bristles in two rows on segments two to seven (Text-fig. 23) *Platycarenum*
Dorsal abdominal bristles in one row on segments two to seven (Text-figs. 10 and 27) *Anabarrhynchus*
3. Sheath of labrum short, not reaching to edge of sheath of proboscis, as in Text-figures 29 and 38 4
Sheath of labrum long, reaching beyond edge of sheath of proboscis, as in Text-figure 41 5
4. First abdominal segment with very small spines or without spines; on segments 2-7 abdominal spines strong (Text-figs. 30 and 33) *Ectinorrhynchus*
First abdominal segment with long spines; on segments 2-7 abdominal spines slender (Text-fig. 36) *Taenogera*
First abdominal segment with long spines; on segments 2-7 abdominal spines slender (Text-fig. 36) *Acraspisa*
5. Abdominal spines strong (Text-figs. 42 and 45) *Agapophytus*
Abdominal spines slender (Text-fig. 39) *Acupalpa*

CONCLUSIONS.

Therevid larvae are found frequently in gardens and bushland soil, but they are apparently of no economic importance, and the adult flies are inoffensive; these facts probably explain why there is so little published information on their life history.

The keys given for the larvae and pupae described in this paper are tentative only, for one cannot say whether the characters selected will be of use for other genera. For the larvae it was necessary to find very small differences to distinguish them, and it would be difficult, if not impossible, to identify the living larvae. The pupae, on the whole, are more readily distinguished, but it was impossible to separate satisfactorily the genus *Ectinorrhynchus* from the genus *Taenogera*. I hesitated to use the small differences in the abdominal spines because these vary considerably in different individuals of the same species and they even vary on the two sides of the same individual.

The specimens used in the preparation of this paper, e.g. the adult flies with pupal exuviae and slide mounts of the larval exuviae, have been deposited in the Macleay Museum at the University of Sydney.

ACKNOWLEDGEMENTS.

The writer is indebted to Professor P. W. F. Murray and Mr. A. R. Woodhill, Department of Zoology, University of Sydney, who made available laboratory accommodation at the Department; and to Mr. J. S. Mann, of the Biological Section, Department of Public Lands, Queensland, who identified the adult flies.

References.

- BHATIA, H. L., 1934.—A Note on the Life-history of *Psilocephala sequa* Walker (Fam. Therevidae: Diptera). *Ind. Jour. Sci.*, Delhi, iv, pp. 203-204, 1 pl.
- BRAUER, F., 1883.—*Denks. K. Akad. Wiss. Wien, Math. Nat.*, xlvii, p. 29.
- BOUCHÉ, P. F., 1834.—*Naturgeschichte der Insecten*, pp. 45-46, Taf. 4, f. 16-20.
- COLLINGE, W. E., 1909.—Observations on the Life-history and Habits of *Thereva nobilitata* Fabr. and other Species. *Jour. Econ. Biol.* iv, pp. 14-17, 1 pl.
- FELT, E. P., 1912.—*N.Y. State Mus. Bull.*, 155, Ann. Report, p. 121.
- ISSAC, P. V., 1925.—Some Observations on the Life History and Habits of *Phycus brunneus* Wied. (*Thereva*). *Mem. Dept. Agric. India, Calcutta, Ent. Ser.* ix, pp. 29-30, 1 pl.
- LUNDBECK, W., 1908.—*Diptera Danica*, pt. 2, pp. 136-138.
- MACQUART, J., 1841-1850.—*Diptères exotiques nouveaux ou peu connus. Suppl. 1-4.* (Extrait des *Mémoires Société Royale des Sciences de l'Agriculture et des Arts*, de Lille, 1844.) (*A. fasciatus*, 1848, Suppl. 3, p. 32, and 1850, Suppl. 4, p. 102.)
- MALLOCH, J. R., 1915.—Some Additional Records of Chironomidae from Illinois and Notes on other Illinois Diptera. *Bull. Ill. St. Lab. Nat. Hist.*, xi, pp. 334-336.
- MANN, J. S., 1928-1933.—Revisional Notes on Australian Therevidae. Pt. 1, *Aust. Zool.*, v, 1928, pp. 151-194. Pt. 2, *Aust. Zool.*, vi, 1929, pp. 17-49. Pt. 3, *Aust. Zool.*, vii, 1933, pp. 325-344.
- MEIJERE, J. C. H. DE, 1916.—Beiträge zur Kenntnis der Dipteren Larven und Puppen. *Zool. Jahrb. Abt. System.*, xl, pp. 210-214.
- TILLYARD, R. J., 1926.—*Insects of Australia and New Zealand*, p. 362.
- WESTWOOD, J. O., 1840.—*An Introduction to the Modern Classification of Insects*, II, p. 550.
- WILLISTON, S. W., 1896.—*Manual of the Families and Genera of North American Diptera*, p. 68.